

REMARKS

Claims 5 and 9 are pending in this application. By this Amendment, claim 5 is amended. Support for the amendments to claim 5 can be found, for example, at page 6, line 17-page 7, line 17, page 23, line 24-page 24, line 11, Fig. 3, and the claims as filed. No new matter is added. Claims 6-8 and 10-12 are canceled without prejudice to, or disclaimer of, the subject matter recited therein. Accordingly, reconsideration and prompt allowance of the application based on the above amendments and the following remarks is respectfully requested.

I. Rejections Under 35 U.S.C. §102

The Office Action rejects claims 5 and 9 under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 3,558,375 to Engeler (Engeler). The Office Action also rejects claims 5 and 9 under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 3,772,102 to Tiemann et al. (Tiemann). Applicant respectfully traverses the rejections.

Without conceding the propriety of the rejections, and in the interest of advancing prosecution, claim 5 is amended to include the limitations of non-rejected claims 6 and 7. Thus, the rejections are moot.

For at least the reasons stated above, claim 5 is not anticipated by Tiemann. Claim 9 depends from claim 5 and, thus, is also not anticipated by Tiemann. Accordingly, reconsideration and withdrawal of the rejections are respectfully requested.

II. Rejection Under 35 U.S.C. §103

The Office Action rejects claims 5-12 under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 3,960,623 to Gantley (Gantley) in view of U.S. Patent No. 5,409,569 to Seki et al. (Seki). By this Amendment, claims 6-8 and 10-12 are canceled, thus the rejection is moot as to those claims. As to the remaining claims, Applicant respectfully traverses the rejection.

The relevant portion of amended claim 5 recites: "a method for evaluating crystal defects of a silicon wafer comprising: ... the etching solution satisfies at least one of (i) a volume ratio of hydrofluoric acid : nitric acid : acetic acid : water is 1 : 13-17 : 4-8 : 4-8 and/or (ii) includes iodine or iodide in a range from 0.01 g to 0.09 g per 1 liter of total liquid volume of the etching solution" Neither Gantley nor Seki, individually or in combination, teach or suggest each and every feature of amended claim 5.

The Office Action asserts that Gantley discloses etching the surface of a silicon wafer with an etching solution that comprises acetic acid, iodine, nitric acid, and HF. However, the Office Action recognizes that Gantley fails to teach the volume ratio of hydrofluoric acid : nitric acid : acetic acid : water of claim 5. The Office Action uses the teachings of Seki to address the discrepancies of Gantley.

Gantley teaches a method for selectively etching portions of the surface of a semiconductor body. Gantley discloses that if the silicon to be etched is doped to be "P" type, then it has been found that dimetch (hydrofluoric acid, nitric acid, acidic acid, and iodine) works effectively. See, Gantley, col. 3, lines 49-65.

However, Gantley does not describe a volume ratio of hydrofluoric acid : nitric acid : acetic acid : water that is 1 : 13-17 : 4-8 : 4-8 in the etching solution, or that the etching solution includes iodine or iodide in a range from 0.01 grams to 0.09 grams per one liter of total liquid volume of the etching solution, which is a feature of the etching solution of the claimed invention. Thus, Gantley does not describe the etching solution of amended claim 5. Also, Gantley nowhere describes that, by adjusting the etching solution to be an etching solution as recited in amended claim 5, an etching rate can be adjusted to be 100 nm/min or less. Gantley provides no reason or rationale for adjusting the etching solution as claimed.

Additionally, although the silicon in which crystal defects are to be evaluated in amended claim 5, specifically has a low electrical resistive of one $\Omega\cdot\text{cm}$ or less, Gantley

nowhere teaches electrical resistivity of the silicon. On the other hand, the presently claimed invention provides the benefit that "forming an unsaturated peroxide film or stains (a stain film) on the surface of the silicon wafer and etching is prevented. In addition, selectivity of etching is high. Therefore, crystal defects of a silicon wafer with low electrical resistivity are detected with excellent capability of detecting the defects, and the defects are evaluated accurately." Specification, page 6, lines 2-9. This can be achieved by using an etching solution that "satisfies at least one of (i) a volume ratio of hydrofluoric acid : nitric acid : acetic acid : water is 1 : 13-17 : 4-8 : 4-8 and/or (ii) includes iodine or iodide in a range from 1.01 g to 0.09 g per one liter of total liquid volume of the etching solution, and the etching solution is adjusted to have an etching rate of 100 nm/min or less for the silicon wafer."

Further, the motive to apply such an etching solution is in response to the challenge that "when a silicon wafer with low electrical resistivity of one $\Omega\cdot\text{cm}$ or less undergoes selective etching as above, the following problem occurs: an unsaturated oxide film or stains (a stain film) is formed on the etched wafer surface significantly. An etch pitch that must have been formed by selective etching cannot be observed." Specification, page 3, lines 8-15.

On the contrary, Gantley teaches neither the problems nor the effect that are described in the claimed invention as mentioned above. Therefore, Gantley fails to teach or suggest each and every feature of amended claim 5.

Seki does not overcome the deficiencies of Gantley. Seki teaches an etchant containing hydrofluoric acid and oxoacid or oxoacid salt compound in solution, expressed by $Mm(XOn)p$. Seki, col. 2, lines 66-68. Seki teaches that this etchant is used in response to the problems that the use of conventional etching causes: degeneration of a photoresist; deterioration and adhesion between a photoresist and silicon to be treated; and fine patterns can not be achieved. Seki, col. 2, lines 18-33. Thus, the object for etching taught in Seki is a photoresist and not silicon, unlike the object for etching in claim 5 of the present application.

In addition, Seki teaches a different etching solution than the etching solution made of a mixture of hydrofluoric acid, nitric acid, acetic acid, and water that further includes iodine or iodide, as recited as the etching solution of the claimed invention. Namely, Seki teaches that acidic acid acts to damage the photoresist such that portions of the photoresist are dissolved, which changes the photoresist into a porous film. Seki, col. 2, lines 34-41. This has also impeded the conventional etchant from being applied to form fine patterns by denying the inclusion of the acidic acid in etching solutions. That is, Seki teaches away from the features of amended claim 5, which recites a mixture of hydrofluoric acid, nitric acid, acetic acid, and water, which further includes iodine or iodide.

Therefore, Seki neither teaches nor suggests each and every feature of amended claim 5.

Furthermore, the combination of Gantley and Seki does not teach or suggest each and every feature of amended claim 5 and no reason or rationale exists for combining the references and then modifying the resultant combination to practice the claimed invention. In Gantley, the object for etching is a silicon (Gantley, col. 2, lines 48-54 and col. 3, lines 62-65), but the object for etching in Seki is a photoresist (Seki col. 2, lines 28-33). Therefore, it is impossible to combine Gantley and Seki, because the respective objects for etching are completely different, as mentioned above.

For at least the reasons stated above, Gantley and Seki would not have rendered obvious claim 5. Claim 9 depends from claim 5, and thus, would not have been rendered obvious by Gantley and Seki. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

III. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 5 and 9 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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Attachment:

Petition for Extension of Time

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